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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/116,138	07/15/98	ANTHONY	J TI-24953

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EXAMINER

SOUW.B

ART UNIT

PAPER NUMBER

2814

DATE MAILED:

08/18/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

# Office Action Summary

Application No.  
**09/116,138**

Applicant(s)  
**Anthony et al.**

Examiner  
**Bernard Souw**

Group Art Unit  
**2814**



☒ Responsive to communication(s) filed on Jul 15, 1998

☐ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

## Disposition of Claims

☒ Claim(s) 1-40 is/are pending in the application.

Of the above, claim(s) 31-35 is/are withdrawn from consideration.

☐ Claim(s) \_\_\_\_\_ is/are allowed.

☒ Claim(s) 1-30 and 36-40 is/are rejected.

☐ Claim(s) \_\_\_\_\_ is/are objected to.

☐ Claims \_\_\_\_\_ are subject to restriction or election requirement.

## Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on \_\_\_\_\_ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on \_\_\_\_\_ is ☐ approved ☐ disapproved.

☒ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some\* ☐ None of the CERTIFIED copies of the priority documents have been  
☐ received.

☐ received in Application No. (Series Code/Serial Number) \_\_\_\_\_.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\*Certified copies not received: \_\_\_\_\_

☒ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

## Attachment(s)

☒ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 5

☒ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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### **DETAILED ACTION**

1. Applicant's election of claims 1-30 and 36-40 (Group I) in Paper No.6 is acknowledged. The election is made without traverse, as confirmed by Mr. David Denker, Reg. No. 40,987, during a telephone interview on 08/10/99 (see attached Interview Summary). The restriction requirement is therefore made FINAL.

2. Claims 31-35 (Group II) are withdrawn from further consideration by the examiner, 37 CFR 1.142(b) as being drawn to a non-elected invention of a semiconductor device. Election was made in Paper No. 6 and declared as being without traverse during a telephone interview with Mr. David Denker, Reg. No. 40,987 on 08/10/99 (see attached Interview Summary).

3. Applicant's claim for domestic priority under 35 U.S.C. 119(e) is acknowledged. However, the provisional application upon which priority is claimed fails to provide adequate support under 35 U.S.C. 112 for claims 1-40 of this application.

The second application (which is called a continuing application) must be an application for a patent for an invention which is also disclosed in the first application (the parent provisional application); the disclosure of the invention in the provisional application and in the continuing application must be sufficient to comply with the requirements of the first paragraph of 35 U.S.C. 112. See *In re Ahlbrecht*, 168 USPQ 293 (CCPA 1971).

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From the three provisional applications being claimed, i.e., No. 60/053661 entitled "High Permittivity Silicate Gate Dielectric", No. 60/053,617 entitled "High Charge Storage Density Integrated Circuit Capacitor", and No. 60/053,616 entitled "High Permittivity Gate Dielectric", only the second (No. 60/053661) and the third (No. 60/053,616) provisional applications meet the requirements as stated above. The second one (No. 60/053,617) contains subject matters completely outside of the scope and subject matter of the present application (DRAM capacitors).

### ***Objections***

4. The disclosure is objected to because of the following informalities:

In Claim 25, line 4, after " .. *layers and*", before "*second* ..." the word "*set*" is misspelled.

Appropriate correction is required.

5. The following is a quotation of 37 CFR 1.71(a)-(c):

(a) The specification must include a written description of the invention or discovery and of the manner and process of making and using the same, and is required to be in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which the invention or discovery appertains, or with which it is most nearly connected, to make and use the same.

(b) The specification must set forth the precise invention for which a patent is solicited, in such manner as to distinguish it from other inventions and from what is old. It must describe completely a specific embodiment of the process, machine, manufacture, composition of matter or improvement invented, and must explain the mode of operation or principle whenever applicable. The best mode contemplated by the inventor of carrying out his invention must be set forth.

(c) In the case of an improvement, the specification must particularly point out the part or parts of the process, machine, manufacture, or composition of matter to which the improvement relates, and the description should be

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confined to the specific improvement and to such parts as necessarily cooperate with it or as may be necessary to a complete understanding or description of it.

6. The specification is objected to under 37 CFR 1.71 because:

The generic word "metal" and "metal silicate" being used throughout the disclosure include also metals which form conductive silicates, hence not usable as gate insulators. Applicants' use of the generic word "metal" and "metal silicates" are found, for example, on pg. 12/ln.13, pg.14/ln.18, pg.18/ll.1-3, pg.20/ll.1-3, pg.21/ll.18-20, and many others. A restriction to a limited group of metals, including zirconium and hafnium, is given by the Applicants only as examples, e.g., on pg.6/ll.15-19 and pg.15/ll.1-2, but never to specify or to limit the group of metals to be used in the invention. In particular, Table 1 on page 13 includes sodium silicate ( $\text{Na}_2\text{SiO}_3$ ), which is known to be electrically conductive, as disclosed by Neti et al., US Patent # 4,328,082, in Col.7/ll.8-20 and Col.8/ll.5-9.

Restriction to definite groups of metals and metal silicates is required. However, the Applicants are cautioned not to introduce new matter in obviating this objection

### ***Claim Rejections - 35 USC § 112***

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

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8. Claims 1-30 and 36-40 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 1-30 recite the limitation "metal" or "metal silicate(s)", which is generic and encompasses all kinds of metal or metal silicate, including those which are known to be electrically conductive, such as various forms of sodium silicates ( $\text{Na}_2\text{Si}_3\text{O}_7$ ,  $\text{Na}_2\text{SiO}_3$ ), disclosed as being electrically conductive, hence good candidates for solid state electrodes, by Net et al., US Patent # 4,328,082, in Col.7/ll.8-20 and Col.8/ll.5-9.

### ***Claim Rejections - 35 USC § 103(a)***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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Insofar as in compliance with 35 USC 112 § 1, as applied previously, claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of Hsieh et al.

Wu describes a method for fabricating a field effect device having a high permittivity gate dielectric, comprising steps which render obvious the limitations of the present application. However, Wu uses silicon oxynitride as the high permittivity gate dielectric.

Hsieh et al. disclose a method of using high permittivity dielectric for capacitors. Hsieh's high permittivity dielectric comprises metal silicates, which are formed by oxidation of metal silicides.

The step of providing a single crystal silicon substrate is disclosed by Wu in Col.2/ll.49-51.

The step of forming a high permittivity gate dielectric layer on the substrate is disclosed by Wu in Col.2/ll.66-67 and Col.3/ll.1-8. However, Wu's high permittivity dielectric is silicon oxynitride. Hsieh et al. use metal silicide as high permittivity dielectric, as disclosed in Col.4/ll.29-30 and Col.5/ll.36-44.

The step of forming a conductive gate overlying the high permittivity gate dielectric layer is disclosed by Wu in Col.3/ll.13-16.

It would have been obvious to one having ordinary skill in the art at the time of the invention to apply Wu's method of using high permittivity dielectric as a gate layer in a field effect device, since this would allow submicron device sizes without the danger of gate insulator layer breakdown thereby adopting Hsieh's method of using metal silicates as the high permittivity dielectric..

One would have been motivated to use Hsieh's method of using high permittivity metal silicates as capacitor dielectric to modify Wu's method of forming high permittivity dielectric gate

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insulators in a field effect device, since the gate electrode and the underlying channel region essentially form a pair of capacitor electrodes, with the gate insulator layer functioning as a capacitor dielectric layer.

10. Insofar as in compliance with 35 USC 112 § 1, claims 2-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wu in view of Hsieh et al., and further in view of Gardner et al.

Wu as modified by Hsieh et al. show all the limitations of claim 2, as applied previously, except the steps of forming the metal silicide layer on the silicon substrate. Gardner et al. describe a method of forming various metal silicides for use in a semiconductor device, as disclosed in Col.2/ll.18-23. Gardner's method comprises steps that render obvious all the remaining limitations of claim 2.

In particular,

Regarding claim 2, the step exposing a clean Si surface is an obvious step as known to one skilled in the art. The step of depositing a first metal on the Si surface, followed by the step of annealing in an inert ambient to form a layer of silicide of the first metal, is disclosed by Gardner et al. in Col.6/ll.6-10 & 20-23, and in Col.6/ll.27-38. The step of oxidizing the silicide layer to form a metal silicate layer is disclosed by Hsieh et al. in Col.5/ll.19-66.

Insofar as in compliance with 35 USC 112 § 1, claims 3-11, 12-15, 16-23, 24-25 and 26-30 are objected as being dependent on (a) rejected base claim(s), i.e., claim 1 and/or claim 2.



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Insofar as in compliance with 35 USC 112 § 1, claims 3-11, 12-15, 16-23, 24-25 and 26-30 are also rejected for being obvious to a person skilled in the art. The claim limitations are standard methods for forming metal silicides and metal silicates already known in semiconductor manufacturing technology.

It would have been obvious to one having ordinary skill in the art at the time of the invention to modify Wu's method of using high permittivity dielectric as a gate layer in a field effect device, by Hsieh's method of using metal silicates as the high permittivity dielectric, thereby following Gardner's teaching to form the metal silicide from a silicidation reaction of the silicon substrate and a deposited metal layer in an inert ambient, since the latter is a standard method of forming metal silicide already known in semiconductor manufacturing technology for providing good contacts to source/drain regions.

One would have been motivated to use Gardner's to modify Wu's and Hsieh's, since the use of a standard method such as Gardner's silicidation technique would save time and effort in undue experimentations, thus minimizing the overall cost of device production.

11. Claims 36-40 are rejected for being related as Product by Process to a rejected parent process claim, i.e., claim 2, 12, 16, 24, or 28.

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*Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Technology Center 2800 fax center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989).*

*Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bernard E. Souw whose telephone number is (703) 305-1481. The examiner can normally be reached on Monday-Friday from 8:30am to 5:00 pm.*

*If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chaudury, Olik, can be reached on (703) 306-2794. The fax number for the organization where this application or proceeding is assigned is (703) 308-7722 or -7724.*

*Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center receptionist at (703) 308-0956.*

*BES*

*Bernard E. Souw*

*August 12, 1999*

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***Restriction/Election***

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
  - I. Claims 1-30 and 36-40, drawn to the process of making a semiconductor device, classified in class 438, subclass 287.
  - II. Claims 31-35, drawn to a structure of a semiconductor device, classified in class 257, subclass 1+.

2. The inventions are distinct, each from the other because:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)).

In the instant case, a field effect device comprising a gate insulator/dielectric layer made of metal silicate can be produced by forming the metal silicate gate dielectric layer by any other method different than the specific processes used in the six distinctive embodiments of the present disclosure, including those presently unknown and/or undisclosed.

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Obviously, the above example satisfies the second version for the distinctness of an invention cited above.

3. Because these inventions are distinct for the reasons given above and the search required for Group I is not required for Group II, restriction for examination purposes as indicated is proper.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a petition under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

5. During a telephone conversation with Mr. Christopher L. Maginniss, Reg. No. 30,288 on 08/03/99, a provisional election was made to prosecute the invention of Process of Making a Semiconductor Device, Claims 1-30 and 36-40. Affirmation of this election must be made by applicant in replying to this Office action. Claims 31-35 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

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*Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bernard E. Souw whose telephone number is (703) 305-3303. The examiner can normally be reached on Monday-Friday from 8:30 am to 5:00 pm.*

*If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudury, can be reached on (703) 305-2794. The fax number for the organization where this application or proceeding is assigned is (703) 308-7722 or -7724.*

*Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center receptionist at (703) 308-0956.*

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Bernard E. Souw

August 6, 1999

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